Dual Channel Oscilloscopes
PM3212B - PM3216B

9444 032 128.1 9444 032 168.1

Supplement to instruction manual PM3212 or PM3216
Ergänzung zur Gerätehandbuch PM3212 oder PM3216
Supplément à la notice d'emploi et d'entretien PM3212 ou PM3216

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PRINTED IN THE NETHERLANDS

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1. General information

This information adapts the PM 3212 or PM 3216 instruction manual to the PM 3212B or PM 3216B model and contains only additional and substitutive information.

1.1. INTRODUCTION

The battery model oscilloscope is identical to the standard model with the exception of the built-in battery supply.
This portable version can be used for at least three hours on batteries and has facilities for recharging the batteries in two different ways, namely, a trickle-charge mode and a fast-charge mode.
A trickle charge is given automatically to the batteries when the instrument is connected to the mains supply and switched on.
A fast charge is given automatically to the batteries when the instrument is connected to the mains supply but is switched off. In this mode, the POWER-ON pilot lamp serves to indicate the state of the batteries. If the batteries are being charged with the maximum current of 300 mA, the pilot lamp flashes once per second.
On completion of the charge, i.e. when the batteries are fully charged, the pilot lamp is momentarily extinguished once every 2. . .5 seconds. Under all other working conditions of the instrument, the pilot lamp blinks continuously.
The internal batteries are fully protected against over-charging when the instrument is left in the charge position for a prolonged time period.
Similarly, at the other extreme, the internal batteries are protected against excessive discharge. At the same time, this prevent the oscilloscope being used on too low a battery supply (lower limit approximately 22.3 V), thus avoiding measuring errors.
The instrument can still be operated on an external d.c. supply of 22.7 V to 27.7 V (floating input).

1.2. CHARACTERISTICS

– Unchanged.

1.2.1. C.R.T.

– Unchanged.

1.2.2. Vertical amplifier

Add: – Capacitance from cabinet to earth (when powered from internal battery)

160 pF with rubber feet standing on an earthed metal plate; not less than 1 m^2.

23 pF oscilloscope 30 cm above an earthed metal plate; not less than 1 m^2.

1.2.3. Time base

– Unchanged

1.2.4. Triggering

– Unchanged.

1.2.5. X Deflection

– Unchanged.

1.2.6. Calibration generator

– Unchanged.

1.2.7. Power supply

— Sources available	a.c. mains supply external battery supply internal battery supply

1.2.7.1. Power from mains

AC supply:	Double insulated	Safety class II, IEC 348 first edition
Nominal voltage range	110, 127, 220, 240 V a.c. ± 10 % 100 V nominal ± 10 %	Optionally available
Nominal frequency range	50 ... 400 Hz ± 10 %	
Power consumption	29.5 W max.	At nominal line voltage

1.2.7.2. Power from external battery

DC supply:		
Voltage range	22.7 V to 27.7 V d.c.	Floating input ($V_{float\ max.}$ = 42 V)
Current rating	1.1 A max.	

1.2.7.3. Power from internal battery

Operating period with fully-charged battery (scale illumination dimmed)

— continuous service	3 hours
— intermittent service	3¼ hours

duty cycle 50 %, max. ON-time 30 min.

The internal battery is switched off automatically if the voltage drops below 22.3 V to prevent excessive discharge and faulty operation of the oscilloscope by insufficient supply voltage.

Fast-charge of internal battery

— charging period	10 hours approx. from fully discharged state
— Power consumption	17 W max. at nominal line voltage
— charging rate	0.3 A max. at nominal line voltage
— charge indication	POWER ON pilot LED blinks once per second
— end-of-charge indication	POWER ON pilot LED momentarily extinguishes once every 2. . .5 seconds

There is no facility to charge the internal battery from the external d.c. supply or to charge the external battery through the oscilloscope charger from the mains supply.

Internal battery details:

— type	Sonnenschein 4GX 3S	or equivalent
— number	3	
— rating	8 V at 3 Ah	

1.2.8. Environmental characteristics

The environmental data are valid only if the instrument is checked in accordance with the official checking procedures. Details on these procedures and failure criteria are supplied on request by the PHILIPS organisation in your country, or by N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, HOLLAND.

Ambient temperature:

Internal batteries removed

— rated range of use	+5 °C ... +40 °C	
— limit range of use	−10 °C ... +55 °C	
— storage and transit	−40 °C ... +70 °C	

Internal batteries installed

— rated range of use	+5 °C ... +35 °C	
— limit range of use	−10 °C ... +35 °C	when mains powered
	−10 °C ... +40 °C	when battery powered
	−10 °C ... +45 °C	when on fast-charge
— storage and transit	−25 °C ... +50 °C	

Humidity	According to IEC 68 Db
Vibration	30 minutes in each of three directions, 10 ... 150 Hz; 0.7 mm p-p and 5 g
Bump	1000 Bumps of 10 g, ½ sine 6ms duration in each of 3 directions
Altitude:	
– operating	5000 m (475 mbar)
– not operating	15000 m (100 mbar)
Recovery time	30 minutes when instrument is subjected to temperature rise from –10 °C to +20 °C at 60 % relative humidity.
EMI	Storgrad "K" VDE

1.2.9. Mechanical data

Dimensions:

– maximum length	(excluding control)	443.5 mm;
	including handle	553.5 mm
– maximum width		300.0 mm;
	including handle	338.5 mm
– maximum height		137.0 mm;
	including feet	145 mm

Weight 11 kg approx.

1.3 ACCESSORIES

1.3.1. Supplied with the instrument

– Unchanged.

1.3.2. Optional

– Unchanged.

2. Directions for use

2.1. Installation

Power source selection

TABLE OF CONDITIONS

Mains plug connected to mains (Line)	*External battery connected to rear socket*	*Power switch On or Off*	*Result*
Yes	No	On	Oscilloscope powered from mains. Internal battery trickle-charged at 30 mA maximum.
No	No	On	Oscilloscope powered from internal battery
Yes	–	Off	Internal battery on fast charge of 300 mA maximum.
No	Yes	On	Oscilloscope powered from external battery.
Yes	Yes	On	Oscilloscope powered from mains or from external battery depending on voltage level. Internal battery trickle-charged at 30 mA maximum.
No	–	Off	Instrument switched off and batteries disconnected.

1. Allgemeines

Die vorliegende Information ist als Anpassung der PM 3212 oder PM 3216 gedacht und enthält nur zusätzliche und ergänzende Einzelheiten.

1.1. EINLEITUNG

Das Batterieversion Oszilloskop und die Standardversionen sind mit Ausnahme der eingebauten Batteriespeisung völlig identisch.
Diese tragbare Ausführung kann mindestens drei Stunden mit Batterien betrieben werden und umfasst eine Einrichtung zum Wiederaufladen der Batterien auf zweierlei Weise, nämlich Pufferladung und Schnelladung.
Eine Pufferladung der Batterien erfolgt automatisch sobald das Gerät an das Netz angeschlossen und eingeschaltet wird.
Ein Schnelladung der Batterien erfolgt automatisch wenn das Gerät an das Netz angeschlossen und ausgeschaltet ist. Bei dieser Ladeweise dient die POWER ON Signallampe zur Anzeige des Zustands der Batterien. Wenn die Batterien mit dem Maximalstrom von 300 mA geladen werden dann leuchtet die Signallampe einmal pro Sekunde auf. Nach Beendigung der Ladung, d.h. wenn die Batterien völlig aufgeladen sind, dann erlischt die Signallampe kurzzeitig alle 2 bis 5 Sekunden unter allen Betriebsbedingungen des Geräts blinkt die Signallampe andauernd.
Die internen Batterien sind voll geschützt gegen Uberladung wenn das Gerät längere Zeit in Ladezustand gelassen wird.
Im entgegengesetzten Fall sind die Batterien gleichermassen gegen übermässige Entladung geschützt. Zugleich wird dadurch verhindert dass das Oszilloskop an zu niedriger Batteriespeisung betrieben wird (unterer Grenzwert etwa 22,3 V), wodurch sich Messfehler vermeiden lassen.
Betrieb des Gerät mit externer Gliechspannungsspeisung von 22.7 V bis 27.7 V (schwebender Eingang) ist ebenfalls möglich.

1.2. TECHNISCHE DATEN

– Unverändert

1.2.1. Elektronenstrahlröhre

– Unverändert

1.2.2. Vertikalverstärker

Zufügen: – Kapazität von Gehäuse gegen Erde (bei Speisung von interner Batterie)

160 pF mit Gummifüssen auf einer geerdeten Metallplatte nicht kleiner als 1 m^2 stehend.

23 pF mit dem Oszilloskop 30 cm über einer geerdeten Matellplatte nicht kleiner als 1 m^2.

1.2.3. Zeitbasis

– Unverändert.

1.2.4. Triggerung

– Unverändert.

1.2.5. X-Ablenkung

– Unverändert.

1.2.6. Kalibriergenerator

– Unverändert.

1.2.7. Versorgung

– Vorhandene Quellen	Aus einem AC Netz Externe Batteriespeisung Interne Batteriespeisung	

1.2.7.1. Stromversorgung vom Netz

AC-Speisung	Doppelt isoliert		Schutzklasse II, IEC 348 Erster Ausgabe
Nennspannungsbereich	110, 127, 220, 240 V AC	± 10 %	
	100 V nominal	± 10 %	Wahlweise erhältlich
Nennfrequenzbereich	50 ... 400 Hz	± 10 %	
Leistungsaufnahme	29,5 W max.		Bei Netznennspannung

1.2.7.2. Versorgung mit externer Batterie

DC-Speisung:		
Spannungsbereich	22.7 V bis 27.7 V DC	Schwebender Eingang ($V_{schweb.\ max.}$ = 42 V)
Stromaufnahme	1.1 A max.	

1.2.7.3. Versorgung mit interner Batterie

Betriebszeit mit voll geladener Batterie (Skalenbeleuchtung gedämpft)

– Ununterbrochener Betrieb	3 Stunden
– Unterbrochener Betrieb	3¼ Stunden

bei einem Zyklus von 30 Minuten "AN" und minimal 30 Minuten "AUS".

Sobald die Spannung unter 22.3 V abfällt wird die interne Batterie automatisch abgeschaltet um übermässige Entladung und somit fehlerhaften Betrieb des Oszilloskops durch ungenügende Speisespannung zu verhindern.

Schnelladung der internen Batterie

– Ladedauer	etwa 10 Stunden, von gänzlich entladenem Zustand
– Leistungsaufnahme	17 W max. bei Netznennspannung
– Ladestrom	0.3 A max. bei Netznennspannung
– Ladungsanzeige	Signal LED "POWER ON" blinkt einmal pro Sek.
– Ladungsende Anzeige	Signal LED "POWER ON" leuchtet und erlischt nach jeweils 2 bis 5 Sek.

Ladung der internen Batterie über die externe Gleichspannung oder Ladung der externen Batterie über die Netzspannung ist nicht möglich.

Interne Batterie Daten

– type	Sonnenschein 4GX 3S	oder gleichwertig
– Anzahl	3	
– Kapazität	8 V bei 3 Ah	

1.2.8. Umgebungsbedingungen

Die Umgebungsdaten gelten nur, wenn das Gerät gemäss dem offiziellen Prüfverfahren kontrolliert wird. Einzelheiten betreffend diese Verfahren sowie Funktionsstörungs-Kriterien sind auf Anfrage bei der Philips-Organisation Ihres Landes oder bei N.V. PHILIPS'GLOEILAMPENFABRIEKEN, ABTEILUNG TEST- UND MESSGERÄTE, EINDHOVEN, HOLLAND erhältlich.

Umgebungstemperatur:

Interne Batterien entfernt

Nominaler Betriebsbereich	+5 °C ... +40 °C	
Zugelassener Betriebstemperaturbereich	–10°C ... +55 °C	
Lagerung und Transport	–40°C ... +70 °C	

Interne Batterien eingebaut

Normaler Betriebsbereich	+5 °C ... +35 °C	
Höchstzulässiger Betriebsbereich	–10 °C ... +35 °C	Bei Netzspannung
	–10 °C ... +40 °C	Bei Batteriespeisung
	–10 °C ... +45 °C	Bei Schnelladung
Lagerung und Transport	–25 °C ... +50 °C	
Luftfeuchte	Entspricht den IEC 68 dB Bedingungen	

Vibration	30 Minutes in jeder der 3 Richtungen, 10 - 150 Hz; 0.7 mm Spitze-Spitze und 5 g
Stossfestigkeit	1000 Stösse je 10 g ½ Sinus, Dauer 6ms in jeder der 3 Richtungen
Höhe	
– Betriebsfähig	5000 m (475 mbar)
– Nicht betriebsfähig	15000 m (100 mbar)
Erholungszeit	30 Minuten wenn die Temperatur des Gerätes von –10 °C auf +20 °C erhöht wird, bei 60 % relativer Luftfeuchtigkeit
Funkstörungen	Störgrad "K" VDE

1.2.9. Mechanische Daten

Abmessungen:

– Maximale Länge	(ohne Bedienelemente)	443.5 mm;
	einschliesslich Handgriff	553.5 mm
– Maximale Breite		300.0 mm;
	einschliesslich Handgriff	338.5 mm
– Maximale Höhe		137.0 mm;
	einschliesslich Füsse	145 mm
Gewicht		etwa 11 kg

1.3. ZUBEHÖREN

1.3.1. Mitgeliefert

– Unverändert.

1.3.2. Wahlzubehör

– Unverändert

2. Gebrauchsanleitung

2.1. INSTALLIERUNG

Wahl der Stromquelle

BEDINGUNGEN			
Steckerverbindung mit Netz	*Externe Batterie mit Buchse an der Rückwand verbunden*	*Netzschalter ON oder OFF*	*Ergebnis*
Ja	Nein	On	Oszilloskop von Netz gespeist. Interne Batterie Pufferladung, 30 mA max.
Nein	Nein	On	Oszilloskop von interner Batterie gespeist
Ja	–	Off	Interne Batterie Schnelladung, 300 mA max.
Nein	Ja	On	Oszilloskop von externer Batterie gespeist
Ja	Ja	On	Oszilloskop, je nach Spannungspegel, von Netz oder von externer Batterie gespeist. Interne Batterie Pufferladung, 30 mA max.
Nein	–	Off	Oszilloskop aus- und interne Batterie abgeschaltet.

1. Généralités

La présente information permet d'obtenir la notice pour le PM 3212 ou PM 3216 version B à partir de la notice PM 3212 ou PM 3216 et ne contient que des données complémentaires et remplaçantes.

1.1. INTRODUCTION

L'oscilloscope du type alimentation par batteries est identique aux version standards à l'exception de l'alimentation par batteries incorporée. Cette version portative peut être utilisée pendant au moins trois heures; de plus, il est possible de recharger les batteries de deux façons différentes, en mode de charge permanente et en mode de charge rapide.

La charge permanente s'obtient automatiquement en branchant l'appareil au secteur et en le mettant en circuit.

La charge rapide s'obtient automatiquement en branchant l'appareil au secteur sans le metrre en circuit. Dans ce mode, le témoin POWER ON sert à indiquer la condition des batteries. Si les batteries sont chargées par le courant maximal de 300 mA, le témoin clignote une fois par seconde. Lorsque les batteries sont chargées au maximum, le témoin s'étient toutes les 2 à 5 secondes. Dans toutes autres conditions de travail, le témoin est continûment allumé.

Les battteries internes sont entièrement protégées contre la surcharge au cas où l'appareil est rechargé pendant une période prolongé.

De même, les batteries interne sont protégées contre une décharge excessive. L'oscilloscope ne peut donc pas être utilisé à trop faible alimentation par batteires (limite inférieure environ 22,3 V), ce que évite les erreurs de mesure.

L'appareil peut aussi être utilisé sur alimentation continue externe de 22,7 V à 27,7 V (entrée flottante).

1.2. CARACTÉRISTIQUES TECHNIQUES

– Inchangées.

1.2.1. Tube à rayons cathodiques

– Inchangé

1.2.2. Amplificateur vertical

A ajouter: – capacité du coffret à la terre (en cas d'alimentation par batteries)

160 pF avec pieds de caoutchouc sur plaque métallique mise à la terre d'une surface d'au moins 1 m^2

23 pF oscilloscope 30 cm au-dessus d'une plaque métallique mise à la terre d'une surface d'au moins 1 m^2.

1.2.3. Base de temps

– Inchangé

1.2.4. Déclenchement

– Inchangé

1.2.5. Déviation X

– Inchangé

1.2.6. Générateur d'étalonnage

– Inchangé

1.2.7. Alimentation

– Sources disponibles	alimentation secteur en alternatif alimentation externe par batteries alimentation interne par batteries

1.2.7.1. Alimentation secteur

En alternatif	double isolation	class de sécurité II, CEI 348 premier édition
Gamme de tension nominale	110, 127, 220, 240 V alternatif ± 10 % 100 V nominal ± 10 %	 en option
Gamme de fréquence nominale	50 ... 400 Hz ± 10 %	
Consommation	29,5 W	pour tension secteur nominale

1.2.7.2. Alimentation externe par batteries

En continu		
Gamme de tension	22,7 à 27,7 V continu	Entrée flottante ($V_{flot\ max.}$ = 42 V)

1.2.7.3. Alimentation interne par batteries

Période de fonctionnement avec batteries entièrement chargées (éclairage d'échelle sur minimum)

– fonctionnement continu 3 heures
– fonctionnement intermittent 3¼ heures
Ceci vaut pour cycle de 30 min. en service max. et un minimum de 30 min. hors service.

La batterie interne est automatiquement mise hors circuit dès que la tension est inférieure à 22,3 V, et ce pour éviter la décharge excessive et le fonctionnement incorrect de l'oscilloscope par alimentation insuffisante.

Recharge rapide de la batterie interne

– période de charge	10 heures environ en partant de la condition déchargée
– consommation	17 W max. à tension secteur nominale
– taux de charge	0,3 A max. à tension secteur nominale
– indication de charge	le témoin LED "POWER ON" clignote une fois par seconde
– indication charge totale	le témoin LED "POWER ON" est allumé et s'étaint toutes les 2 à 5 secondes

Il n'est pas possible de charger la batterie interne à partir d'une source continue externe ou de charger la batterie externe par le chargeur de l'oscilloscope via le secteur.

Caractéristiques de batterie interne

– type	Sonnenschein 4GX 3S	ou équivalent
– nombre	3	
– capacité	8 V à 3 Ah	

1.2.8. Conditions ambiantes

Les données relatives aux conditions ambiantes ne sont valables que si l'instrument est contrôlé conformément aux methodes officielles. Des renseignements sur ces méthodes et sur les critères employés sont fournis sur demande par l'organisation Philips de votre pays ou par le TEST AND MEASURING DEPARTMENT de la N.V. PHILIPS'GLOEILAMPENFABRIEKEN à EINDHOVEN, PAYS-BAS.

Température ambiante:

Sans batteries internes

– gamme de référence d'utilisation	+5 °C ... +40 °C
– gamme limite d'utilisation	–10 °C ... +55 °C
– conditions de stockage et de transport	–40 °C ... +70 °C

Avec batteries internes

– Gamme de référence d'utilisation	+5 °C ... +35 °C	
– Gamme limite d'utilisation	–10 °C ... +35 °C	par secteur
	–10 °C ... +40 °C	par batterie
	–10 °C ... +45 °C	par charge rapide
– Conditions de stockage et de transport	–25 °C ... +50 °C	

Humidité	Suivant IEC 68 Db
Essais de vibration	30 minutes dans chacune des 3 directions; 10-150 Hz; amplitude 0.7 $mm_{c.c.}$ et 5 g
Chocs	1000 chocs de 10 g, ½ sinus d'une durée de 6ms dans chacune des 3 directions
Altitude maximum:	
– en fonctionnement	5000 m (475 m bars)
– hors fonctionnement	15000 m (100 m bars)
Temps de rétablissement	30 minutes si la température l'instrument passe de −10 °C à +20 °C sous humidité relative de 60 %
EMI	Störgrad "K" VDE

1.2.9. Caractéristiques mécaniques

Dimensions:

– Longueur maxi	(commandes non comprises)	443,5 mm;
	poignée comprise	553,5 mm
– Largeur maxi		300,0 mm;
	poignée comprise	338,5 mm
– Hauteur maxi		137,0 mm;
	pieds compris	145 mm
Poids		11 kg env.

1.3. ACCESSOIRES

1.3.1. Fournis avec l'instrument

– Inchangé.

1.3.2. En option

– Inchangé.

2. Mode d'emploi

2.1. INSTALLATION

Sélection de source d'alimentation

CONDITIONS			
Fiche secteur branché au secteur (réseau)	*Batterie externe connectée à la la douille arrière*	*Interrupteur marche/arrêt*	*Résultat*
Oui	Non	marche	Oscilloscope alimenté par secteur. Batterie interne en charge permanente à 30 mA max.
Non	Non	marche	Oscilloscope alimenté par batterie interne
Oui	—	arrêt	Batterie interne sur charge rapide de 300 mA max.
Non	Oui	marche	Oscilloscope alimenté par batterie externe
Oui	Oui	arrêt	Oscilloscope alimenté par secteur ou batterie externe en fonction du niveau de tension. Batterie interne sur charge parmanente à 30 mA max.
Non	—	arrêt	Oscilloscope hors service et batterie déconnectée

3. Service data

3.1. Block Diagram Description of the Battery Supply Unit (fig. 1).

3.1.1. Fast charge mode

When the instrument is connected to the mains and switch POWER ON is in position "OFF", the RELAY CIRCUIT K1701 is energised.
The internal batteries are connected via the RELAY CIRCUIT K1701 contact to the HI-LIM CUT-OUT circuit (D1704). This circuit compares the battery level with a reference voltage to monitor the state of the battery.
If the battery level exceeds the reference; i.e. the battery is fully charged, the HI-LIM CUT-OUT circuit gives a high positive output. In this state, electronic switches V1722 and V1723 are cut off and the FAST CHARGE and TRICKLE CHARGE circuits are disconnected.
If the battery level is lower than the reference; i.e. the battery requires charging, the HI-LIM CUT-OUT circuit gives a low positive output. This causes the electronic switches V1722 and V1723 to open and the FAST CHARGE and TRICKLE CHARGE circuits are connected. This is the normal circuit operation for fast charging.
A signal output from the HI-LIM CUT-OUT circuit is also routed to electronic switch V1742 which is permanently closed during the fast-charge condition. This permits the BISTABLE MULTIVIBRATOR to supply the RC-GENERATOR circuit with a 0.5 sec pulse which, via the TRANSFORMER-RECTIFIER circuit, flashes the POWER-ON LED once every second to denote fast-charging.
When the battery is fully charged, the HI-LIM CUT-OUT circuit output is high positive, and the charging circuits are disconnected by electronic switches V1722 and V1723. At the same time, electronic switch V1742 is conductive and the resulting asymmetrical switching of the BISTABLE MULTIVIBRATOR causes to generate for about 3 seconds and to switch off for 0.5 seconds.

3.1.2. Trickle charge mode

In this mode the instrument is also connected to the mains and switch POWER is in position ON. Since in this mode, the emitter of V217 from the power supply of the oscilloscope is connected to V1728, the electronic switch V1726 is non-conducting and the FAST CHARGE circuit is not operated.

3.1.3. Mains operation

When the instrument is used on mains supply, RELAY CIRCUIT K1702 is not operated. In this case the contacts of relay K1702 are in rest-position. Now the oscilloscope is supplied by the +28 V connected via diode V1717 to the positive side of capacitor C208 (positive rail of the instrument's power supply).

3.1.4. Battery operation

When the instrument is used only on batteries, and switch POWER is in position ON, RELAY CIRCUIT K1701 and RELAY CIRCUIT K1702 both energise. The contacts of K1702 feed the d.c. output from the batteries to +C208.
If the battery voltage decreases to approximately 22.3 V, the LO-LIM CUT-OUT circuit output becomes low positive and the RELAY CIRCUIT K1702 releases and the battery voltage is disconnected from the instrument. The instrument remains cut off and the battery only delivers a slight current to its control circuits. At approx. 18 V the RELAY CIRCUIT K1701 also drops out and the battery circuits are completely disconnected, thus safeguarding them against complete discharge. External battery connection is available via the contacts, which are in rest-position, of RELAY CIRCUIT K1702.

3.2. CIRCUIT DESCRIPTION (fig. 2).

When the instrument is plugged into the mains, transformer T1701 is directly connected and together with the bridge rectifier V1701 provides a d.c. voltage, the positive side of which is connected via L1701 to the internal batteries G1701-G1703. Dependent upon the position of the instrument POWER ON switch, two charging rates of the internal batteries can be provided.

3.2.1. Fast charge mode

With the instrument connected to the mains and switch POWER ON not operated, relay K1701 is energised by the load voltage via conducting transistor V1706.
The internal batteries are connected, via the contact of K1701, to both a low-limit (LO-LIM) and a high-limit (HI-LIM) comparator circuit to ascertain their condition.

High-limit cut-out circuit

In the high-limit comparator circuit, amplifier D1704, the batteries are connected to input 3, via the HI-LIM cut-out control R1742. Input 2 serves as a temperature-controll reference voltage, derived from zener diodes V1737, V1738, V1739 and V1741. So long as the battery voltage on input 3 is lower than the reference voltage on input 2, the output on pin 6 of D1704 is low positive, and charging occurs.
In this condition, switching transistors V1722 and V1723 become conductive due to this low positive voltage applied to their bases.
The fast charge circuit operates via V1722 and R1718. In the fast charge mode the trickle-charge circuit is included and charging also occurs via V1723 and R1719. The charging current is determined by the setting of the preset potentiometer R1731, which controls the input potential of pin 3 on amplifier D1702.

Charge indication circuit

An indication of charging is given by the POWER ON LED flashing once every second. The circuit operates as follows:
During charging, the low positive output on pin 6 of D1704 is also applied to block zener diode V1743, and the switching transistor V1742 is non-conductive. In this case, the +28 V collector voltage of V1742 is applied via R1749 to the base of V1746, one side of a bistable multivibrator circuit (V1744/V1746), to provide an output signal with a symmetrical mark-space ratio.
The output pulses are taken from the emitter of V1746 to an RC-generator circuit. This comprises transistor V1748 with a three-stage RC feedback network between its collector and base. The transformer T1702 serves to isolate the circuit from the POWER ON LED, which is connected to the instrument cabinet.
The rectified output pulses from T1702 secondary winding are smoothed by filter V1712, R1758 and applied to the POWER ON LED, which flashes once every second.
When the battery is fully charged, input 3 of D1704 is at a higher potential than the reference potential on input 2. This results in a high positive output on pin 6 and the charging circuits are disconnected; i.e. switching transistors V1722 and V1723 are cut off. In addition, the positive output on D1704 pin 6 is routed via zener diode V1743 to switch on transistor V1742. This results in a loser voltage, of approx. 10x, on the base of V1746 and consequently an unequal mark-space ratio from the bistable multivibrator. The RC-generator circuit V1748 is now generating for approximately 3 seconds and non-generating for approx. 0.5 seconds. This causes the POWER ON LED to flash with a ½ -second interruption every 3 seconds, denoting that the batteries are fully charged.

3.2.2. Trickle charge mode

In this mode, with the instrument connected to the mains and switched to POWER ON, the negative potential derived from the emitter of the series regulator V217 (in the OSCILLOSCOPE power supply) is applied via diodes V1728 and V1727 to cut off transistor V1726. This causes the potential at the junction of R1723, R1724 to be more positive, thereby causing input 3 of D1702 to be more positive than input 2.
Consequently, the resulting high positive output on pin 6 is applied via diode V1721 to cut off the switching transistor V1722. This leaves only the trickle-charge in operation, via switching transistor V1723 and resistor R1719. The trickle-charging current is regulated by choice of the circuit components to a maximum of 30 mA.

3.2.3. Mains operation

When the instrument is used on mains supply (instrument connected to the mains and switched to POWER ON) the base of transistor V1714 will be positive and this transistor will conduct. Now the base potential of transistor V1713 becomes low and transistor V1713 will cut off. So, the contacts of relay K1702 are in rest-position and the instrument is supplied by the +28 V via diode V1717.

3.2.4. Battery operation

When the instrument is used only on batteries, both relay circuits K1701 and K1702 energise and the battery output is connected via the contacts of relay K1702 to the instrument positive supply rail.
A drop in the battery voltage to 22.3 V will result in input 2 of D1701 becoming higher than input 3. In this event, the output on pin 6 is low positive and transistor V1713 cuts off. No current is available for relay K1702 and the battery supply is therefore disconnected from the instrument by relay contacts K1702.
The low positive output on pin 6 of D1701 is connected via feedback resistor R1709 to pin 3 to make it more negative. In this way, the instrument remains off and the battery only delivers a slight current (approx. 20 mA), to its control circuit. To safeguard against discharging the batteries completely, relay K1701 drops out at approximately 18 V and disconnects the control circuits.

3.2.5. External battery supply

The provision for external batteries is via the isolating diode V1718 and the rest-position of the relay K1702 contacts. By means of the positive potential, via diode V1719, transistor V1714 is conductive when external batteries are used. This transistor serves to switch off V1713, which ensures that the relay K1702 is not energised; i.e. the external batteries are connected direct to the instrument positive supply rail via the rest-contacts of K1702.

3.3. CHECKING AND ADJUSTING THE INTERNAL BATTERY CONTROL CIRCUIT

The battery control circuit must only be adjusted at an ambient temperature of 15 . . . 40 °C, as indicated in table 1.

The tolerances mentioned in this chapter only apply for a newly adjusted instrument and may deviate from the values mentioned in chapter TECHNICAL DATA.

Note: Do not check and adjust the instrument in a draughty room, because of the adverse effects of draught.

3.3.1. LO-LIM CUT-OUT CIRCUIT

- Disconnect the instrument from the mains.
- Disconnect the battery connections from the control unit.
- Connect an external power supply (0 . . . 30 V, 1,5 A), terminated with a resistance of 47 Ω, 25 W, to the battery connections on the control unit. The + output of the power supply must be connected to the connection pin with the red dot and the – output to the other connection pin.
- Connect in series with the positive supply line a mA-meter class 2, ranges 1 A and 100 mA.
- Adjust the output voltage of the external power supply to 26 V ± 1 V.
- Switch on the instrument.
- Decrease the output voltage of the external power supply to such a value, that relay K1702 just releases. Check with a digital voltmeter that the voltage is 22.3 V ± 50 mV the voltage drop across the mA-meter added.

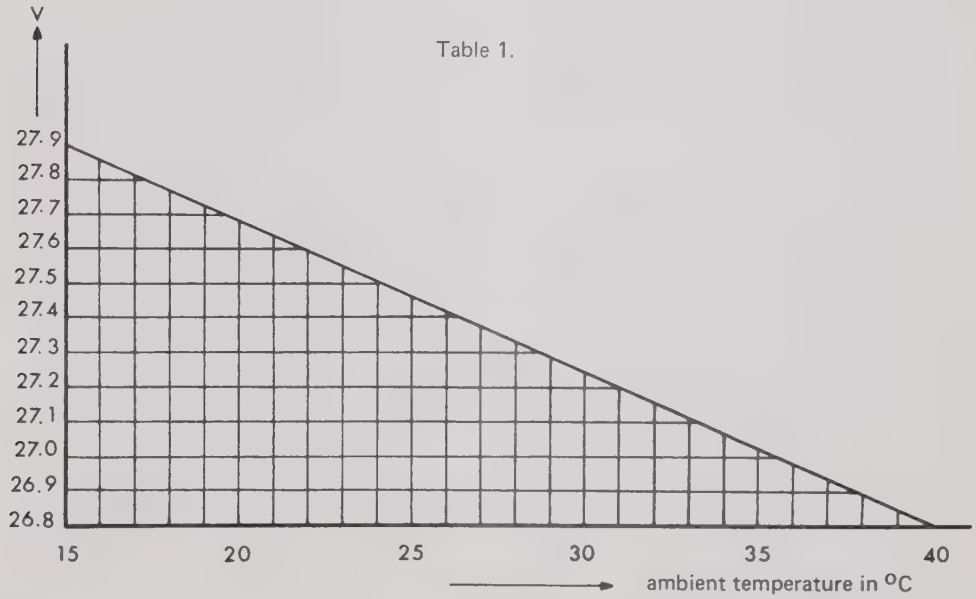
If the release voltage is not within the above mentioned tolerance, proceed as follows:
- Turn potentiometer R1703 fully to the left.
- Increase the output voltage of the external power supply until relay K1702 just becomes effective.
- Now adjust the output voltage of the external power supply to 22.3 V ± 50 mV (measure with digital voltmeter) the voltage drop across the mA-meter added.
- Turn potentiometer R1703 slowly to the right until relay K1702 just releases.

Slowly increase the output voltage of the external power supply until relay K1702 just becomes effective again. This must happen between 24 and 28 V.

3.3.2. Checking and adjusting the HI-LIM CUT-OUT circuit

- Switch off the instrument.
- Adjust the external power supply to 26 V ± 200 mV.
- Connect the instrument to the mains (220 V ± 1,5%).
- Check that the mA-meter indicates 300 mA ± 20 mA, if not, readjust potentiometer R1731.
- Increase the mains voltage to 242 V ± 1,5%, check that the mA-meter indicates a current of ⩽ 450 mA.
- Decrease the mains voltage to 198 V ± 1,5%, check that the mA-meter indicates a current of ⩾ 150 mA.
- Adjust the mains voltage to 220 V ± 1,5% again.
- Switch the instrument ON, check that the mA-meter indicates a current of 5 . . . 30 mA.
- Switch the instrument OFF.
- Now adjust the external power suplly to a value belonging to the ambient temperature as indicated in table 1. Check that the mA-meter indicates a current of 100 . . . 150 mA, if not readjust potentiometer R1742.

Table 1.



3.3.3. Checking and adjusting the blinking frequency of the pilot lamp indicating the state of the battery charge

- Increase the external power supply output voltage 100 mV in respect of the voltage set as indicated in table 1.
- Check that the mA-meter indicates a current of ⩽ 30 mA.
- Check that the pilot lamp (LED B1) blinks once per second.
- Decrease the external power supply output voltage 100 mV in respect of the voltage set, as indicated in table 1.
- Check that the pilot lamp blinks once every second.
- Remove the external power supply.
- Connect the mA-meter between the battery connection pins on the control unit.
- Check that the mA-meter indicates a current of ⩽ 425 mA.
- Switch the instrument ON.
- Check that the mA-meter indicates a current of ⩽ 70 mA.
- Switch off the instrument.
- Disconnect the instrument from the mains.
- Disconnect the mA-meter.
- Connect the batteries to the control unit again (red wire to the connection pin with the red dot).

3.3.4. Final check

- Switch on the instrument and discharge the batteries.
- Switch off the instrument and connect it to the mains. Charge the batteries during 16 hours.
- Disconnect the instrument from the mains and switch on. Discharge the batteries with scale illumination to minimum. Discharging time 2.5 . . . 3.5 hours.
- Connect the instrument to the mains and switch on.
  Charge the batteries during 24 hours.

3.4. PARTS LIST

Capacitors

Item	Ordering number	Farad	Tol. (%)	Volts	Description
C1701	4822 124 20484	15 µ	−10/+50	40	Electrolytic
C1702	5322 121 40323	100 n	10	100	Polyester
C1703	5322 121 40323	100 n	10	100	Polyester
C1704	4822 124 20484	15 µ	−10/+50	40	Electrolytic
C1706	4822 124 20484	15 µ	−10/+50	40	Electrolytic
C1707	4822 122 31222	220 p	2	100	Ceramic
C1708	4822 122 31222	220 p	2	100	Ceramic
C1709	4822 122 31222	220 p	2	100	Ceramic
C1711	4822 124 20482	2.2 µ	−10/+50	40	Electrolytic
C1712	4822 124 20484	15 µ	−10/+50	40	Electrolytic

Resistors

Item	Ordering number	Ohm	Tol. (%)	Type	Remarks
R1701	5322 116 50479	15,4 k	1	MR25	Metal film
R1702	5322 116 54595	5,11 k	1	MR25	Metal film
R1703	5322 100 10118	22 k	20	0,5 W	Pre-set potentiometer
R1704	5322 116 50451	21,5 k	1	MR25	Metal film
R1706	5322 116 50608	6,19 k	1	MR25	Metal film
R1707	5322 116 54629	14 k	1	MR25	Metal film
R1708	5322 116 54595	5,11 k	1	MR25	Metal film
R1709	5322 116 50451	21,5 k	1	MR25	Metal film
R1711	5322 116 54643	20,5 k	1	MR25	Metal film
R1712	5322 116 54643	20,5 k	1	MR25	Metal film
R1713	5322 116 50479	15,4 k	1	MR25	Metal film
R1714	5322 116 54595	5,11 k	1	MR25	Metal film
R1716	5322 116 50479	15,4 k	1	MR25	Metal film
R1717	5322 116 54595	5,11 k	1	MR25	Metal film
R1718	4822 112 21045	4,7	5	4.2 W	Wire wound
R1719	5322 116 54448	59	1	MR25	Metal film
R1721	5322 116 54595	5,11 k	1	MR25	Metal film
R1722	5322 116 50479	15,4 k	1	MR25	Metal film
R1723	5322 116 54627	13,3 k	1	MR25	Metal film
R1724	5322 116 54627	13,3 k	1	MR25	Metal film
R1726	5322 116 54696	100 k	1	MR25	Metal film
R1727	5322 116 54595	5,11 k	1	MR25	Metal film
R1728	5322 116 54558	8,25 k	1	MR25	Metal film
R1729	5322 116 50479	15,4 k	1	MR25	Metal film
R1731	5322 100 10118	22 k	20	0.5 W	Preset potentiometer
R1732	5322 116 54643	20,5 k	1	MR25	Metal film
R1733	5322 116 54619	10 k	1	MR25	Metal film
R1734	5322 116 54619	10 k	1	MR25	Metal film
R1736	5322 116 54619	10 k	1	MR25	Metal film
R1737	5322 116 54643	20,5 k	1	MR25	Metal film
R1738	5322 116 54558	8,25 k	1	MR25	Metal film
R1739	5322 116 54668	44,2 k	1	MR25	Metal film
R1741	5322 116 50442	48,7 k	1	MR25	Metal film
R1742	5322 100 10118	22 k	20	0.5 W	Pre-set potentiometer
R1743	5322 116 54643	20,5 k	1	MR25	Metal film

Item	Ordering number	Ohm	Tol. (%)	Type	Remarks
R1744	5322 116 54619	10 k	1	MR25	Metal film
R1746	5322 116 54549	1 k	1	MR25	Metal film
R1747	5322 116 54643	20,5 k	1	MR25	Metal film
R1748	5322 116 54696	100 k	1	MR25	Metal film
R1749	5322 116 54696	100 k	1	MR25	Metal film
R1751	5322 116 54643	20,5 k	1	MR25	Metal film
R1752	5322 116 54696	100 k	1	MR25	Metal film
R1753	5322 116 54643	20,5 k	1	MR25	Metal film
R1754	5322 116 54619	10 k	1	MR25	Metal film
R1756	5322 116 54619	10 k	1	MR25	Metal film
R1757	5322 116 54549	1 k	1	MR25	Metal film
R1758	5322 116 50679	237	1	MR25	Metal film

Diodes

Item	Ordering number	Type
V1701	5322 130 30414	BY164
V1702	5322 130 30613	BAW62
V1703	5322 130 34281	BZX79-C15
V1704	5322 130 30613	BAW62
V1707	5322 130 34499	BZX79-B20
V1708	5322 130 34197	BZX79-C12
V1709	5322 130 34048	BZX75-C2V8
V1711	5322 130 30613	BAW62
V1712	5322 130 34048	BZX75-C2V8
V1716	5322 130 34499	BZX79-B20
V1717	5322 130 34633	BY227
V1718	5322 130 34633	BY227
V1719	5322 130 30613	BAW62
V1721	5322 130 30613	BAW62
V1724	5322 130 30613	BAW62
V1727	5322 130 34048	BZX75-C2V8
V1728	5322 130 30613	BAW62
V1729	5322 130 30432	BYX36-150
V1731	5322 130 30432	BYX36-150
V1732	5322 130 30432	BYX36-150
V1733	5322 130 34278	BZX79-C6V8
V1734	5322 130 30613	BAW62
V1736	5322 130 30613	BAW62
V1737	5322 130 34382	BZX79-C8V2
V1738	5322 130 30765	BZX75-C3V6
V1739	5322 130 30765	BZX75-C3V6
V1741	5322 130 30765	BZX75-C3V6
V1743	5322 130 34499	BZX79-B20
V1747	5322 130 30613	BAW62
V1749	5322 130 30613	BAW62
V1751	5322 130 30613	BAW62
V1752	5322 130 30613	BAW62
V1753	5322 130 30613	BAW62

Transistors

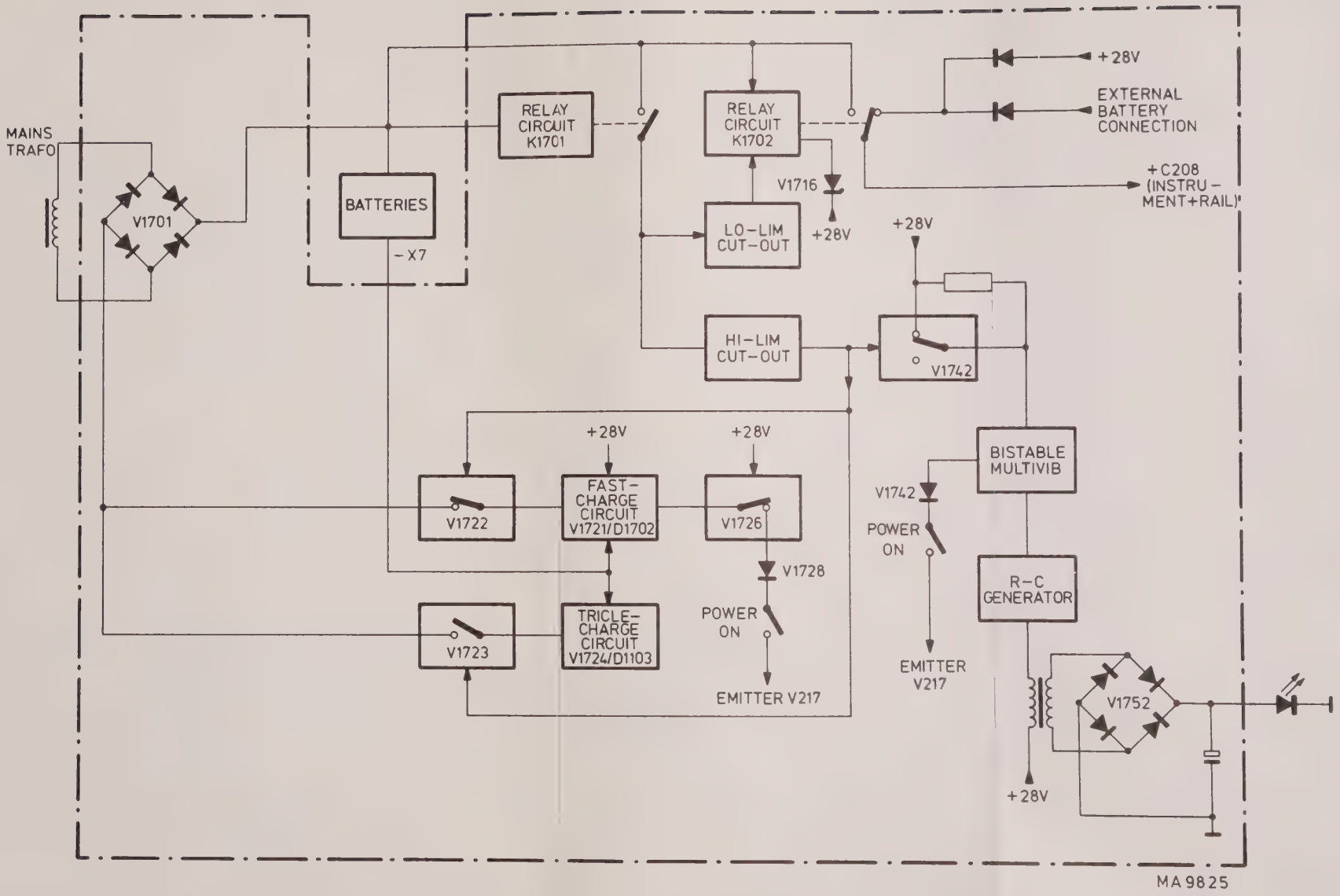
Item	Ordering number	Type
V1706	5322 130 44461	BC546B
V1713	5322 130 44461	BC546B
V1714	5322 130 44461	BC546B
V1722	5322 130 44357	BD262
V1723	5322 130 40665	BD138
V1726	5322 130 44461	BC546B
V1742	5322 130 44461	BC546B
V1744	5322 130 44461	BC546B
V1746	5322 130 44461	BC546B
V1748	5322 130 44461	BC546B

Integrated circuits

Item	Ordering number	Type
D1701	5322 209 85254	LM741CN
D1702	5322 209 85254	LM741CN
D1704	5322 209 85254	LM741CN
D1705	5322 209 85254	LM741CN

Miscellaneous

Item	Fig.	Qty.	Ordering number	Description
1	5	1	4822 280 20064	Reed relay assy. K1701
2	5	1	5322 280 84087	Relay K1702
3	5	1	5322 281 64154	Coil L1701
4	6	1	5322 146 44038	Mains transformer for B-version T1701
5	5	1	5322 142 64068	Transformer T1702
6	5	1	5322 216 54154	Control unit A1701


MAINS TRAFO
V1701
BATTERIES
-X7
RELAY CIRCUIT K1701
RELAY CIRCUIT K1702
+28V
EXTERNAL BATTERY CONNECTION
+C208 (INSTRU-MENT+RAIL)
V1716
+28V
LO-LIM CUT-OUT
HI-LIM CUT-OUT
+28V
V1742
+28V
+28V
V1722
FAST-CHARGE CIRCUIT V1721/D1702
V1726
V1728
POWER ON
EMITTER V217
V1723
TRICLE-CHARGE CIRCUIT V1724/D1103
BISTABLE MULTIVIB
V1742
POWER ON
EMITTER V217
R-C GENERATOR
V1752
+28V
MA 9825

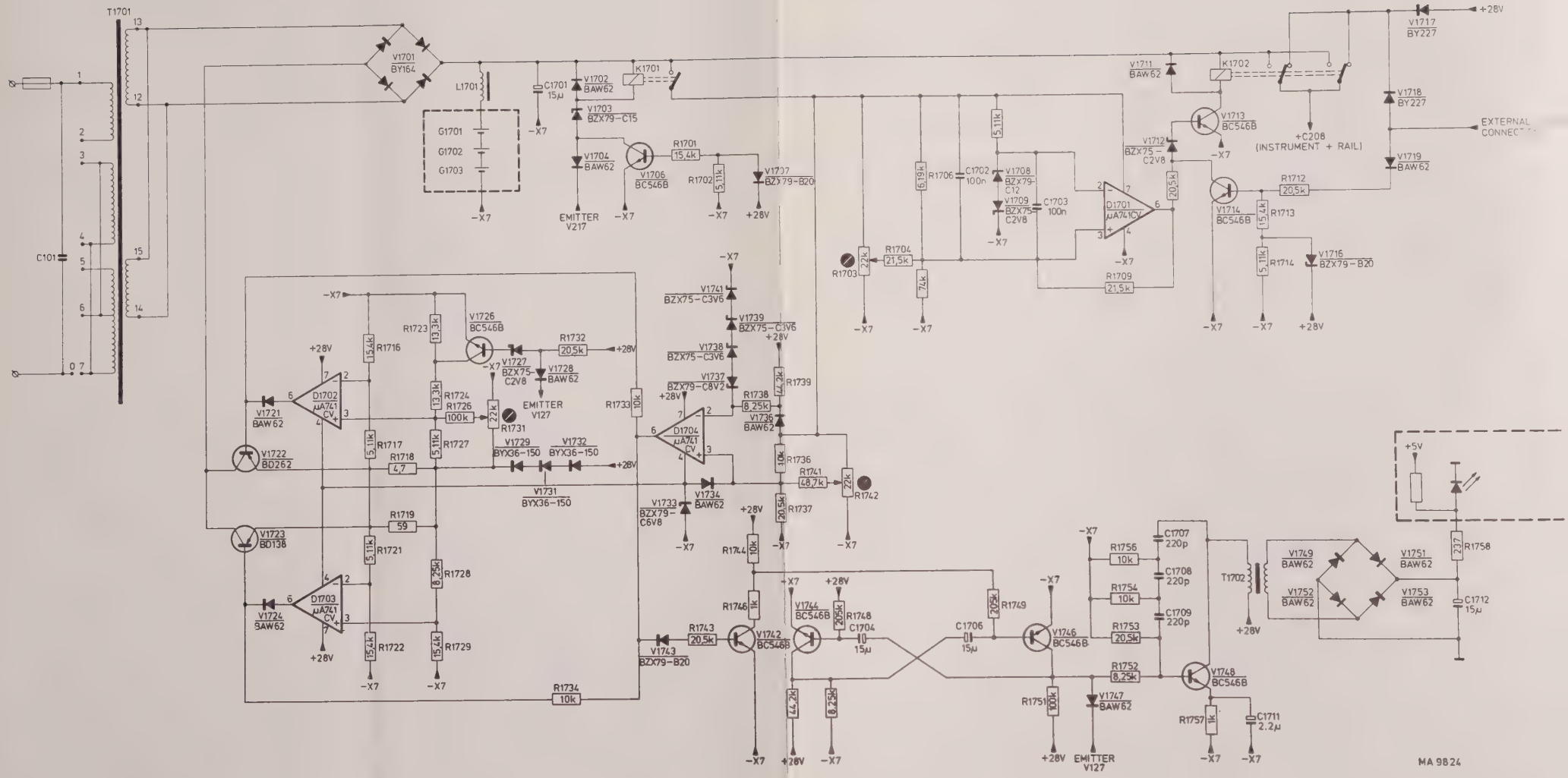
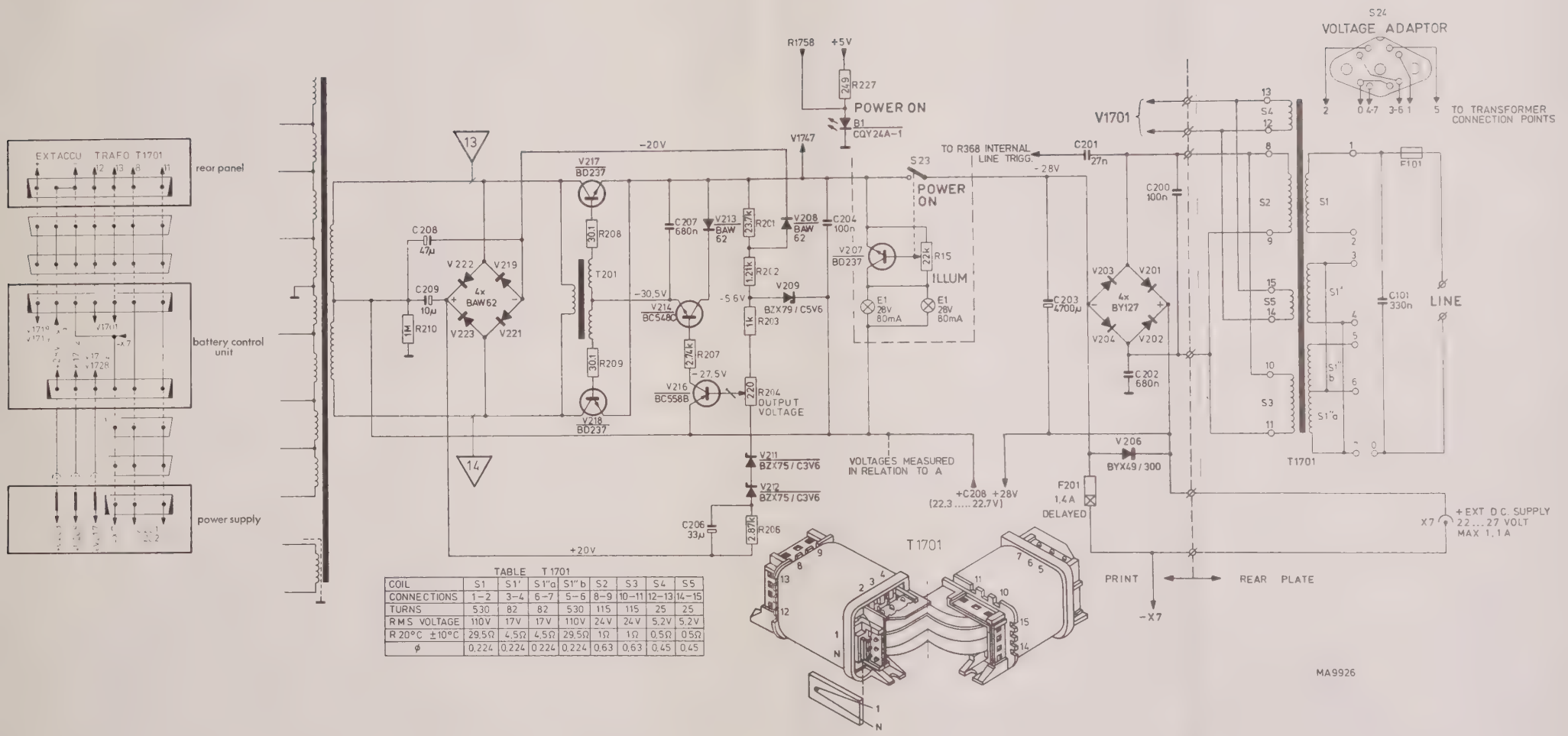

T1701
C101
V1701 BY164
L1701
G1701
G1702
G1703
C1701 15µ
V1702 BAW62
K1701
V1703 BZX79-C15
V1704 BAW62
V1706 BC546B
R1701 15,4k
R1702 5,11k
V1707 BZX79-B20
EMITTER V217
V1711 BAW62
K1702
V1712 BZX75-C2V8
V1713 BC546B
V1717 BY227
V1718 BY227
V1719 BAW62
+C208 (INSTRUMENT + RAIL)
EXTERNAL CONNEC...
R1703 22k
R1704 21,5k
R1706 6,19k
C1702 100n
V1708 BZX79-C12
V1709 BZX75-C2V8
C1703 100n
D1701 µA741CV
R1709 21,5k
R1712 20,5k
V1714 BC546B
R1713 15,4k
R1714 5,11k
V1716 BZX79-B20
V1721 BAW62
V1722 BD262
V1723 BD138
V1724 BAW62
D1702 µA741 CV
D1703 µA741 CV
R1716 15,4k
R1717 5,11k
R1718 47
R1719 59
R1721 5,11k
R1722 15,4k
R1723 13,3k
R1724 13,3k
R1726 100k
R1727 5,11k
R1728 8,25k
R1729 15,4k
V1726 BC546B
V1727 BZX75-C2V8
V1728 BAW62
R1731 22k
EMITTER V127
R1732 20,5k
V1729 BYX36-150
V1732 BYX36-150
V1731 BYX36-150
R1733 10k
R1734 10k
V1741 BZX75-C3V6
V1739 BZX75-C1V6
V1738 BZX75-C3V6
V1737 BZX79-C8V2
D1704 µA741 CV
R1738 8,25k
R1739 44,2k
V1736 BAW62
R1736 10k
R1741 48,7k
R1742 22k
V1734 BAW62
V1733 BZX79-C6V8
R1737 20,5k
R1744 10k
V1743 BZX79-B20
R1743 20,5k
V1742 BC546B
R1746 1k
V1744 BC546B
R1748 205k
C1704 15µ
C1706 15µ
R1749 205k
V1746 BC546B
R1751 100k
V1747 BAW62
R1752 8,25k
R1753 20,5k
R1754 10k
R1756 10k
C1707 220p
C1708 220p
C1709 220p
V1748 BC546B
R1757 1k
C1711 2,2µ
EMITTER V127
+5V
T1702
V1749 BAW62
V1751 BAW62
V1752 BAW62
V1753 BAW62
R1758 237
C1712 15µ
MA 9824

Fig. 2.



COIL	S1	S1'	S1"a	S1"b	S2	S3	S4	S5
CONNECTIONS	1–2	3–4	6–7	5–6	8–9	10–11	12–13	14–15
TURNS	530	82	82	530	115	115	25	25
RMS VOLTAGE	110V	17V	17V	110V	24V	24V	5.2V	5.2V
R 20°C ±10°C	29.5Ω	4.5Ω	4.5Ω	29.5Ω	1Ω	1Ω	0.5Ω	0.5Ω
ø	0.224	0.224	0.224	0.224	0.63	0.63	0.45	0.45

TABLE T 1701

Fig. 3.

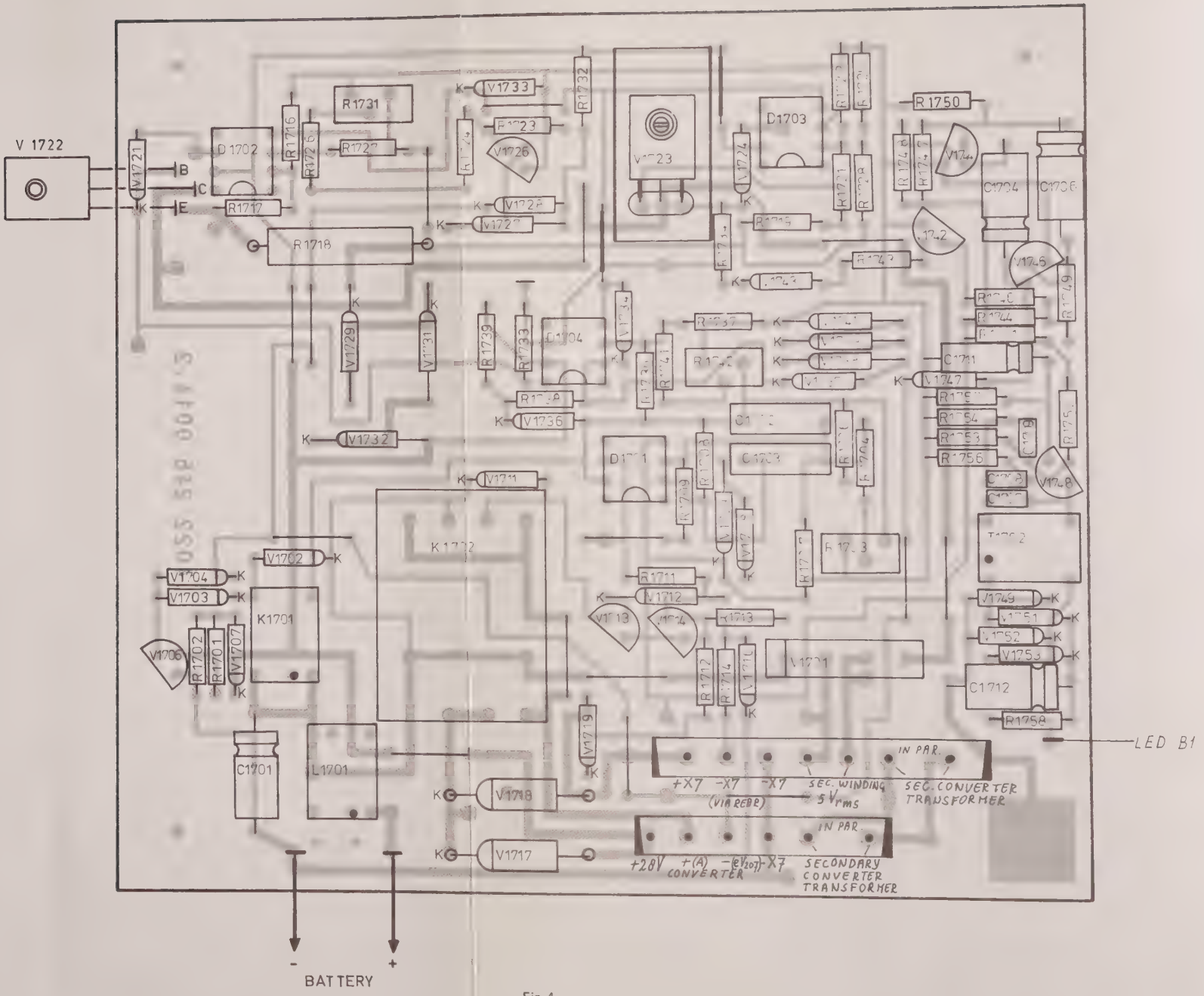

V 1722
B
C
E
R1731
R1718
D1703
R1750
C1704
C1706
C1711
C1712
K1701
L1701
C1701
V1733
V1726
V1729
V1731
V1732
V1736
V1702
V1704
V1703
V1706
V1707
V1711
V1712
V1713
V1719
V1718
V1717
V1747
V1748
V1749
V1751
V1752
V1753
R1758
LED B1
IN PAR.
+X7 -X7 -X7 SEC. WINDING
(VIA REDR)
5 Vrms
SEC. CONVERTER TRANSFORMER
+28V +(A) CONVERTER
SECONDARY CONVERTER TRANSFORMER
BATTERY
-
+

Fig. 4.

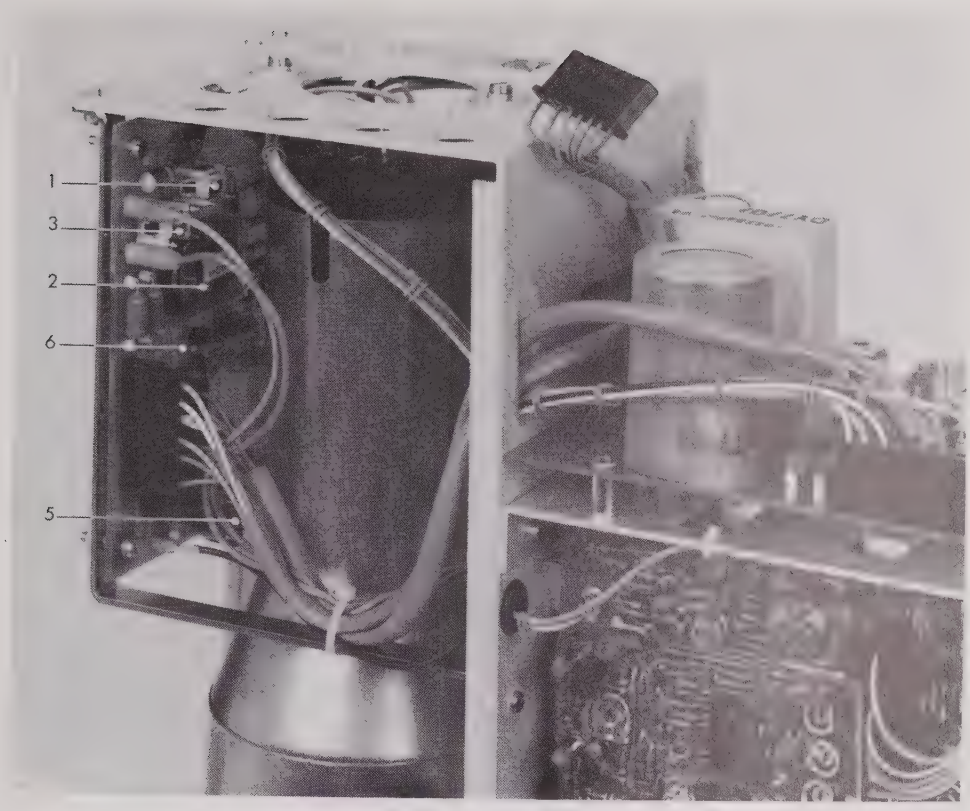


Fig. 5.

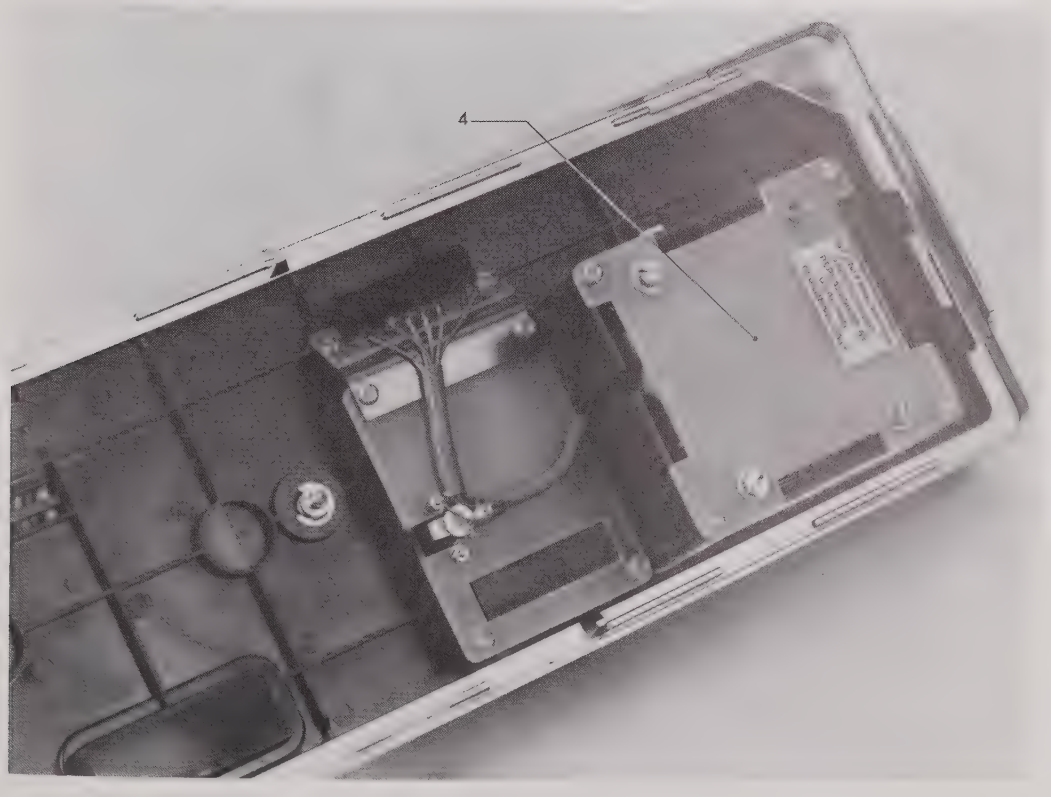


Fig. 6.

PHILIPS

PHILIPS

SERVICE

Scientific & Analytical Equipment
Test & Measuring Instruments
Industrial Controls
Welding
Industrial Data-processing Systems

Scientific & Industrial Equipment Division

771228 **TEST AND MEASURING INSTRUMENTS** OSC 14

Supplement for PM3212B, PM3214B and battery pack PM8901
PM3216B, PM3218B

Re: Additional battery information for above mentioned typenumbers.

1. General

Manufacturer: Sonnenschein G.m.b.H. D–6470 Buedingen–W. Germany
telex 04 184619

Distribution: These batteries can be ordered in more than 90 countries.

Electrical characteristics: Refer to relevant instruction manuals.

PM 3212B PM 3216B PM 3214B PM 3218B	3x Sonnenschein 4Gx3S - 8V/3Ah.
PM 8901	4x Sonnenschein 3Fx5S - 6V/7,5Ah - 6V/9,5Ah.

2. Charging- and discharging curves

For a correct operating time it is very important that the batteries used together in an instrument in same state of charge, as the batteries are connected in series they share the same charging- and discharging currents.

Example I shows the curves for a set-up of 3 batteries of 8V each in a correct situation.
Example II shows one battery already partly discharged.

Results: – two batteries will be charged too much in charging cycle
– one battery will be too much discharged in discharging cycle
hence : short operating time.

If you are in doubt about the matching of the batteries due to a short operating time, charge each battery on a separate supply.
Use a power supply with current-limitation at about 1/10 of the battery-capacitance and an open output voltage of 2,3V for each cell that the battery comprises (i.e. 9,2V for 8V-and 6,9V for 6V battery).
Doing so you will get a good "starting position" as shown in example I.

3. Defective battery

A defective battery can be detected by measuring the voltage between"+" and "–" terminal in loaded condition (inside a switched-on instrument) and comparing them with the other battery terminal-voltages.
This should be done with batteries in charged condition; in case of doubt first charge each battery separately.

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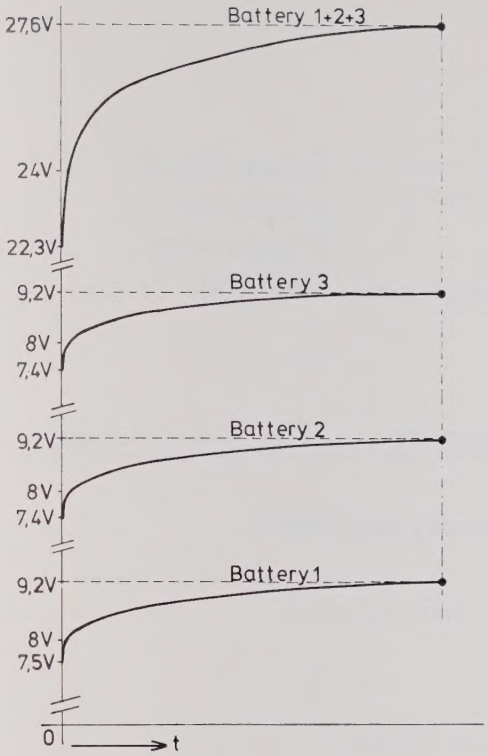
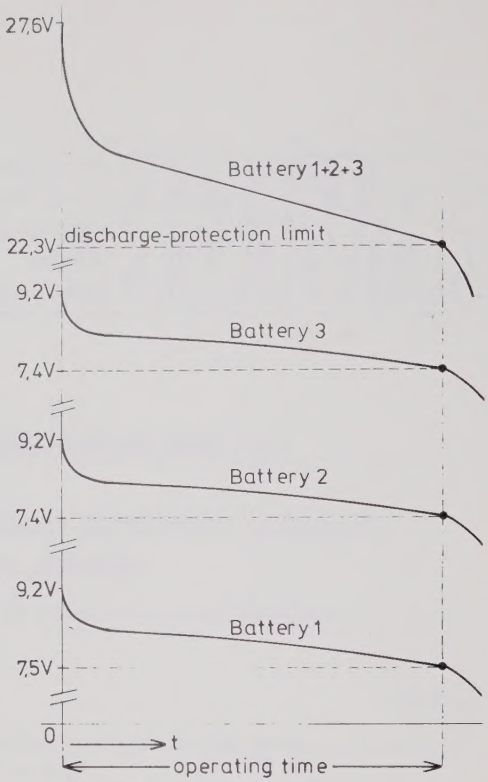
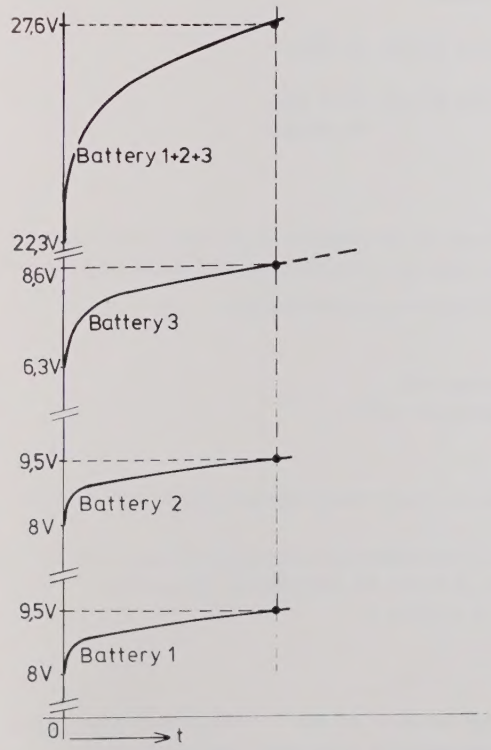


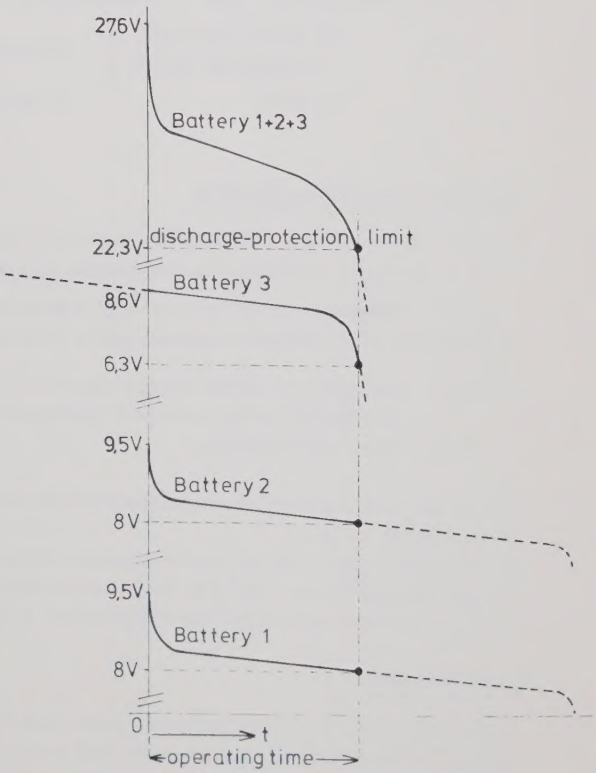
EXAMPLE I: charge curves



EXAMPLE I: discharge curves



EXAMPLE II: charge curves



EXAMPLE II: discharge curves

MAT 1